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IS 9999 (1981): Diesel Locomotives for Use in Mines [MED 8: Mining Techniques and Equipment]

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Indian Standard

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SPECIFICATION FOR DIESEL LOCOMOTIVES FOR USE IN MINES

Mining Sectional Committee, EDC 50; Mine Locomotives Subcommittee, EDC 50 : 9 [Ref : Doc : EDC 50 (3262)]

1. Scope — Covers the requirements for diesel locomotives for use in mines.

1.1 This standard also covers the diesel locomotives with flameproof characteristics (*see* **5.3, 7.7.1.1, 7.7.3** to **7.7.10, 7.10.4** and **7.10.4.1**) for use in underground coal mines.

2. Terminology

2.1 *Static (Adhesive) Weight* — The static weight of a locomotive on powered axles.

2.2 *Installed Power* — The power (in kW) of a diesel engine installed in the locomotive, under standard conditions of test.

2.3 *Maximum Speed* — The maximum speed attainable on a level track by a locomotive at full throttle position.

2.4 *Minimum Continuous Rated Speed* — This is the minimum speed below which the locomotive shall not be permitted to be run under full load for more than five minutes. This criteria is applicable only in case of hydrodynamic transmission where the efficiency is low at low speed.

3. Types — As specified in Table 1.

4. Main Dimensions — As specified in Table 2.

5. Material

5.1 Main components of locomotives shall be manufactured from material as mentioned against each in Table 3 or its equivalent.

5.2 Aluminium, magnesium, titanium or their alloys shall not be used in the construction of any component of locomotives.

5.3 Every locomotive with flameproof characteristics and each of its accessories shall, as far as practicable, be constructed with fire-resistant, preferably self-extinguishing, material. Any inflammable material included therein shall be covered with a substantial metallic covering to render it non-inflammable.

TABLE 1 TYPES OF DIESEL LOCOMOTIVES

(*Clause* 3)

Type		Nominal Static Weight tonnes	Rail Gauge *G* mm
Non-flameproof	Flameproof		
LD5	LDF5	5	600
LD5	LDF5	5	(762)
LD5	LDF5	5	900
LD8	LDF8	8	600
LD8	LDF8	8	(762)
LD8	LDF8	8	900
LD8	LDF8	8	1 000
LD8	LDF8	8	(1 067)
LD12	LDF12	12	900
LD12	LDF12	12	1 000
LD12	LDF12	12	(1 067)

Note — Rail gauge in brackets are non-preferred and shall not be used for new installations.

Adopted 24 September 1981

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Gr 7

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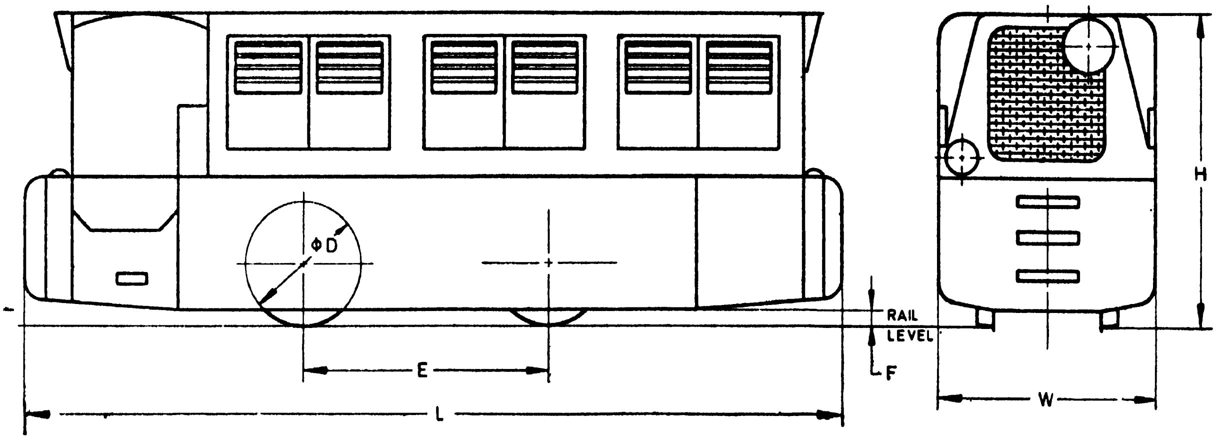
NEW DELHI 110002

TABLE 2 DIMENSIONS, RATINGS AND MAIN PARAMETERS OF DIESEL LOCOMOTIVES

(*Clause* 4)

All dimensions in millimetres.



Type of Locomotives	LD5 or LDF5	LD8 or LDF8	LD12 or LDF12
Static weight, kg	5 000 + 20%	8 000 + 15%	12 000 + 10%
Power of locomotive, kW	22·5 to 30	30 to 37·5	37·5 to 67·5
Length over buffers, *L*, *Max*	3 600	4 750	5 600
Total width, *W*, *Max*	G + 500	G + 500	G + 500
Height over rail level, *H*, *Max*	1 750	1 750	1 750
Wheel base, *E*	950	1 200	1 500
Wheel diameter (rolling), *D*	450 or 540	540 or 680	680
Minimum clearance (worn out wheel) over rail, *F*	50	50	50
Minimum negotiable radius of curvature	7 000	9 000	10 000
Weight of rail per metre, kg	Not less than 14	Not less than 20	Not less than 23
Brake system	Mechanical	Mechanical and pneumatic (optional)	Mechanical and pneumatic
Sanding system	Mechanical	Mechanical	Pneumatic or mechanical

AMENDMENT NO. 1 JULY 1985
TO
IS : 9999 - 1981 SPECIFICATION FOR DIESEL LOCOMOTIVES FOR USE IN MINES

(*Page* 1, *Table* 1) — Add the following in the existing table:

Type		Nominal Static Weight Tonnes	Rail Gauge G mm
Non-flameproof	Flameproof		
LD 15	LDF 15	15	900
LD 15	LDF 15	15	1 000
LD 15	LDF 15	15	(1 067)

(*Page* 2, *Table* 2) — Add the following new column on the existing table:

Type of Locomotives	LD 15 or LDF 15
Static Weight, kg	15 000 + 10%
Power of locomotive, kW	93·5
Length over buffer, *L*, *Max*	5 600
Total width, *W*, *Max*	G + 500
Height over rail level, *H*, *Max*	1 750
Wheel base*, *E*	1 400 – 1 500
Wheel diameter (rolling), *D*	680 or 725
Minimum clearance (Work out wheel) over rail, *F*	50
Minimum negotiable radius of curvature	10 000
Weight of rail per metre, kg	Not less than 23
Brake system	Mechanical and pneumatic
Sanding system	Pneumatic or mechanical

(*Page* 4, *clause* 7.5.1) — Substitute the following for the existing clause:

' **7.5.1** All locomotives shall be equipped with manually operated brakes of either screw type or lever type capable of holding the locomotive with maximum permissible trailing load at the maximum specified gradient. Locomotive of 12 tonnes or above adhesive weight shall be provided with an additional pneumatic brake. Locomotives of less than 12 tonnes adhesive weight may be provided with pneumatic brake as an optional feature. '

(*Page* 5, *clause* 7.7.2.1) — Substitute the following for the existing clause:

'**7.7.2.1** Fire resistant hydraulic fluid of flash point not less than 68°C shall be used. '

(*Page* 5, *clause* 7.7.5.1) — Substitute the following for the existing clause:

'**7.7.5.1** A suitable exhaust conditioner on the exhaust system shall be provided to cool, dilute and render the exhaust gases harmless. '

(*Page* 5, *clause* 7.7.6.2) — Substitute the following for the existing clause:

'**7.7.6.2** The temperature of the exhaust gas issuing from flametrap or conditioner box whichever is later, shall not exceed 85° under any throttle condition. '

(*Page* 6, *clause* **7.7.8.1**, *second sentence*) — Substitute the following for the existing second sentence of the clause:

' Additionally, an alarm may be provided which shall sound continuously till the deficiencies are removed. '

(*Page* 7, *clause* **7.7.10**) — Add the following new clause after **7.7.10**:

' **7.7.11** In case of diesel locomotive with flame proof characteristic, electric starting system shall not be used. '

(*Page* 8, *clause* **7.9**, *Controls*) — Add the following after (f):

' g) Lightening control. '

(*Page* 8, *clause* **7.10.4.1**) — Substitute the following for the existing clause:

' **7.10.4.1** Cable connecting flameproof apparatus shall be either armoured or conduited, the cables being routed away from the hot surfaces. '

(*Page* 9, *clause* **7.11.2**) — Substitute the following for the existing clause:

' **7.11.2** An adequate audible warning signal of approach like gang bell operated by mechanical action shall be provided with addition to electric or pneumatic horn. '

(EDC 50)

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TABLE 3 MATERIALS FOR MAIN COMPONENTS OF THE LOCOMOTIVES

(*Clause* 5.1)

Component	Material Conforming to
1. a) Frame	IS 226 - 1975 ' Structural steel (standard quality) (*fifth revision*) '
b) Frame, if cast	IS : 1030 - 1974 ' Carbon steel castings for general engineering purposes (*first revision*) '
2. *Drive*	
a) Axle, shaft and pins	Fe 570 - HT (St 58 - HT) of IS : 961 - 1975 'Structural steel (high tensile) (*second revision*) ' or Class 4 of IS : 1875 - 1978 ' Carbon steel billets, blooms, slabs and bars for forgings (*fourth revision*) ' or C 45 or 40Cr1Mo28 of IS : 1570 - 1961 'Schedules for wrought steels for general engineering purposes '
b) Pinion shaft and gears	40Cr1, 40Cr1Mo60, 13Ni3Cr80 and 15NiCr1Mo12 of IS : 1570-1961
c) Worm gears	Phosphor bronze, or
d) Wheel tyre	Grade 3A or 3B of IS : 2708 - 1973 ' 1·5 percent manganese steel castings (*first revision*)' or 40Cr1 of IS : 1570 - 1961
e) Wheel centres	Grade 25 of IS : 210 - 1970 ' Grey iron castings (*second revision*)' or Grade 30-57 of IS : 1030 - 1974 or Class 3A or 4 of IS : 1875 - 1978
f) Cast wheel	Grade 2 of IS : 2707 - 1973 ' Carbon steel castings for surface hardening (*first revision*) '
g) Axle box housing, gear box housing and covers of gear box housing	IS : 1030 - 1974 or IS : 226 - 1975
h) Sprocket	Class 1 of IS : 1875 - 1978 or C14 of IS : 4432 - 1967 ' Case hardening steel ' or 40Cr1Mo28 of IS : 1570 - 1961
j) Chains	IS : 2403 - 1964 ' Transmission steel roller chains and chain wheels '
3. *Braking System*	
a) Brake spindle and hinge pins	Class 3A or 4 of IS : 1875 - 1970 or C45 of IS : 1570 - 1961
b) Levers, hanger, etc	IS : 226 - 1975 or equivalent
c) Hand wheel	IS : 1030 - 1974 or Grade 20 of IS : 210 - 1970
d) Brake shoe (without liner)	Grade 15 of IS : 210 - 1970
e) Brake shoe (with liner)	
i) Shoe	Grade 30-57 of IS : 1030 - 1974
ii) Liner	Grade 15 of IS : 210 - 1970
4. *Sanding System*	
a) Levers, tie rods, sand container	Fe 410-S (St 42-S) of IS: 226 - 1975
b) Hinge pins	Medium carbon steel
5. *Buffers, Bracket, Spring Housing*	Grade 30-57 of IS : 1030 - 1974 or Fe 410-S (St 42-S) of IS : 226 - 1975
6. *Suspension Springs, Buffer's Springs, Frame Suspension Springs*	Steel conforming to IS : 3195 - 1965 ' Steel for the manufacture of volute andh elical springs (for railway rolling stock) ' or 55 Si2Mn90 of IS : 1570 - 1961 or IS : 3885 (Part II) - 1969 ' Steel for the manufacture of laminated springs (railway rolling stock): Part II Rib and groove sections '

6. Designation — A diesel locomotive shall be designated by its commonly used name, type, rail gauge for which it is to be used and the number of this standard.

Example: A diesel locomotive (flameproof) of type LBF8 for use on a rail gauge of 900 mm shall be designated as:

Diesel Locomotive 3 LBF8 IS : 9999

Note — The numbers 1, 2, 3, 4 and 5 shall be used to designate the rail gauge of 600, (762), 900, 1 000 and (1 067) mm respectively prior to the type in the designation of the locomotive.

7. General Requirements

7.1 The underframe shall be rigid and robust in construction and basically rectangular in shape. Adequate cross members shall be provided in the underframe for rigidity which may serve as supports for the power pack equipment.

7.2 The drawing and buffing gears shall suit the rolling stock for use in the mines. Locomotives of 12 tonnes static weight shall be provided with spring loaded buffer and draw gear. Other locomotives may be provided with rubber pads between the underframe headstock and the draw gear.

7.3 Cutouts shall be provided in the side plates of the underframe for inspection and assessibility of the brake gear components, sanding gear, etc.

7.4 *Suspension*

7.4.1 The underframe shall be supported on the axle box through springs of either coil or leaf type. The spring gear shall be so designed that the static deflection of each spring under working condition is between 20 and 35 mm.

7.4.2 In case coil spring suspension is used, shock absorber may be provided between the frame and axle boxes only. No shock absorber will be necessary when laminated leaf springs are used for suspension.

7.5 *Brake System*

7.5.1 All locomotives shall be equipped with manually operated brakes of either screw or lever type capable of holding the locomotive at a gradient. Locomotives of 12 tonnes static weight shall be provided with an additional pneumatic brake system which, when operated, shall act on all the wheels.

7.5.1.1 Lever type braking system if provided on the locomotives shall have automatic self-locking arrangements.

7.5.2 In case of pneumatic brake system, the air reservoir pressure shall be 6 to 8 bar and the working pressure for braking systems shall be between 3 to 5 bar.

7.5.2.1 All air pipelines shall be rigidly secured to the underframe by robust clamps and brackets. All pipe joints shall be of compression type as far as possible.

7.5.2.2 Air brake application shall be of graduated application type so that variation of application of brakes is possible through adjustment of the brake valve handle. An emergency brake valve shall be provided separately for use in emergency when the driver's graduated application valve fails to operate.

7.5.2.3 The compressor capacity shall be not less than 16 m^3/h for locomotives with pneumatic brakes.

7.5.3 Braking system of all types of locomotives shall be provided with a suitable arrangement for adjusting clearance between the brake shoe and the wheel tread.

7.6 *Sanding System* — Suitable sanding arrangements shall be provided on the locomotives which can be easily operated from the driver's seat. The sanding arrangements may be of either gravity or pneumatic type and shall allow sand to fall on the rails in front of the wheels both for forward and backward movement of the locomotives.

7.6.1 For pneumatic type of sanding arrangement, suitable device shall be provided in the airline, so that the sand falls on the track and is not blown off.

7.7 *Power Pack*

7.7.1 Water cooled diesel engine of adequate power shall be used. The engine shall be complete with air filters, starting system, fuel and lubricating oil filters, fuel pump and associated cooling system both for the engine and hydraulic transmission, if used.

7.7.1.1 For diesel locomotives with flameproof characteristics, the engine shall be so constructed that together with its associated air intake and exhaust system, it shall be able to withstand without permanent deformation any explosion that may occur within the system and prevent the propagation to the outside atmosphere of any flame or heated particles that may ignite flammable explosive atmosphere.

7.7.1.2 No engine other than that worked by a liquid fuel of flash point not less than 68°C shall be used. The engine shall be of compression ignition type.

7.7.2 *Transmission* — A suitable mechanical or hydraulic transmission shall be provided 'on the locomotives to achieve the required tractive effort.

7.7.2.1 As far as practicable, the use of fire-resistant hydraulic fluid of flash point not less than 68°C is desirable.

7.7.3 *Air intake system*

7.7.3.1 An air-cleaner and a flametrap shall be provided in the air inlet system.

7.7.3.2 Air filters (cleaners) of the dry type shall be preferred but air filters designed to use fire-resistant fluids may also be used.

7.7.4 *Flametrap* — A flametrap shall comply with the following requirements:

a) It shall be interposed between the inlet manifold and the air cleaner.

b) Be so located as to facilitate easy removal for cleaning and maintenance.

c) It shall be designed to prevent incorrect assembly.

d) It shall be so mounted that it is protected, as far as possible, from accidental damage.

e) It shall be constructed of corrosion resistant materials and shall be of adequate strength to minimise the possibility of distortion of components.

f) In case of flametrap of spaced plate type, plates of thickness not less than 1·25 mm and a width (parallel to the flow of inlet air) of not less than 50 mm, shall be so arranged as to provide a maximum uniform gap of 0·5 mm between the plates, and shall be of removable type so that they can be easily cleaned and reassembled.

g) Flametraps other than spaced plate type may be accepted provided they are equal to the flametraps of spaced plate types in performance and are easily removable for inspection, cleaning and replacement.

7.7.5 *Exhaust system*

7.7.5.1 Exhaust gas conditioners of waterbath type, if provided, shall be designed to hold sufficient quantity of water to cool the exhaust gases. The conditioner shall be adequately baffeled to ensure full scrubbing of the gases.

7.7.5.2 The exhaust gas conditioner shall be manufactured from stainless steel or corrosion resistant material.

7.7.5.3 The water capacity of the exhaust gas cooling system shall be sufficient to permit the engine to operate at one-third load factor for a period of 8 hours.

7.7.5.4 The exhaust manifold shall be water cooled and the exhaust pipes leading to the conditioner box shall not be allowed to exceed a surface temperature of 150°C.

7.7.5.5 Flametraps of suitable design, preferably interchangeable with those provided on the air intake system (*see* **7.7.4**), shall be provided on the exhaust system after the conditioner box. It shall be so designed to comply with the requirements of **7.7.7**.

7.7.6 *Exhaust gases* — The exhaust gases, as sampled at the engine exhaust manifold, when the engine is on test, shall not contain under any load condition (idling, half-load, full-load) more than 1 500 ppm and 1 000 ppm of carbon monoxide and oxides of nitrogen respectively.

7.7.6.1 Use of chemical neutralizers may be adopted to achieve the above results.

7.7.6.2 The temperature of the undiluted exhaust gas issuing from flametrap or conditioner box, whichever is later, shall not exceed 85°C under any throttle condition.

7.7.6.3 Provision for sampling of the exhaust gases shall be made in the exhaust system before and after the conditioner box.

7.7.6.4 The exhaust gases shall be discharged in such a manner that they are directed away from the driver's cabin or position of the seat, and also away from the breathing zones of persons likely to be alongside the locomotives.

7.7.7 *Surface temperature* — The system shall be so designed that the external surface temperature of either exhaust system or of the engine shall not exceed 150°C under any load condition.

7.7.7.1 Insulating material shall not be used on any part of the engine or exhaust system.

7.7.8 *Safety control*

7.7.8.1 A device shall be provided to stop the engine automatically when the water level in exhaust gas container goes below a pre-determined minimum level or when the exhaust gas temperature at the outlet of frametrap exceeds 85°C. Alternatively, an alarm may be provided which shall sound continuously till the deficiencies are removed.

7.7.8.2 Any such alarm, if provided, shall be so arranged that its operation does not effect the performance of the traps or other safety equipment operated by the pneumatic system. In case, an air shut-off valve is provided, provision shall be made to prevent water from the conditioner box being sucked into the eagine.

7.7.8.3 Any safety device or alarm provided in accordance with **7.7.8.1** shall prevent restarting of the engine until the water level is replenished or deficiencies are removed.

7.7.9 *Joint*

7.7.9.1 *Combustion chamber* — Joints in the combustion chamber shall comply with the following requirements:

a) The cylinder head joints shall have a minimum width of 9 mm. Taking into account, any gasket interposed between the faces of the joints, the joint shall form a positive seal.

b) The injector body shall be positively sealed to the cylinder head. This seal shall be backed by a flamepath to the surrounding atmosphere with a minimum length of 12·5 mm and a maximum diametral clearance of 0·15 mm or a minimum length of 50 mm and a maximum clearance of 0·5 mm.

c) Diametral clearances between valve stem and valve guides shall not exceed 0·15 mm for a minimum length of 25 mm.

d) Any other non-operational openings into the combustion chamber or inlet and exhaust ports shall be positively sealed in a manner which shall comply with **7.7.9.3** (c).

7.7.9.2 *Inlet and exhaust system including conditioner box* — Joints in this system shall comply with the following requirements:

a) All joints shall be machined and flanged. Suitably designed screw joints may be accepted as an alternative at certain intermediate connections. The flatness tolerances of each surface of mating joints shall not exceed 0·15 mm.

b) The edge of any bolt or stud hole shall be not less than 9 mm from the inner edge of the joint surface. The width of any joint or the length of any flamepath through or across any joint shall not be less than 12·5 mm. For spigot joints, the length of the flamepath may be measured over the spigot and the flange together, provided that both spigot and flange lengths are continuous. For screwed joints, the flamepath is the axial dimension across the threads common to both portions when fully connected together. Screwed joints shall have a minimum of 5 fully engaged threads.

c) When the enclosure is pierced by a valve spindle, a gland shall be provided at which the diametral clearance shall not exceed 0·15 mm for a minimum axial length of 25 mm.

d) Suitable metal clad gaskets or other jointing material shall be interposed between all joint faces except in the case of:

   i) Screwed joints, and

   ii) Joints which need to be broken to remove flametraps. The flanges of such joints shall be of corrosion resistant material and shall have a flatness tolerances at their faces not exceeding 0·075 mm.

7.7.10 *Attachment of components* — Shall comply with the following requirements:

a) *Fuel Pump* — A fuel injection pump shall be so designed that alteration of the setting of the pump is not possible while it is attached to the engine. The pump shall be clearly marked with its rated setting.

b) If removable screws or studs are used for attaching covers for components of an enclosure or for attaching any fitting thereto, the holes for such screws or studs shall not pass through the wall of the enclosure. A thickness of metal not less than 3 mm or one-third of the diameter of the hole, whichever is greater, shall be left at the bottom and around all such holes.

c) If for convenience in manufacture, the holes are drilled through the wall of the enclosure, such holes shall be sealed by the insertion of screwed plug of a length not less than 6 mm or the diameter of the hole whichever is greater. The diameter of any such hole except where it is less than 6 mm, shall be not greater than the thickness of the enclosure wall.

d) Screws, studs or screwed plugs, which are to be permanently attached to the apparatus, shall be securely attached by welding, riveting or other acceptable means.

e) Where set screws or studs inserted in bottomed or blind holes are used for attaching a cover plate or access door or other components, all the set screws or studs for any such component shall be of same length if they are of the same diameter and pitch. The use of screws or bolts of different lengths through holes in the same cover shall be avoided as far as possible.

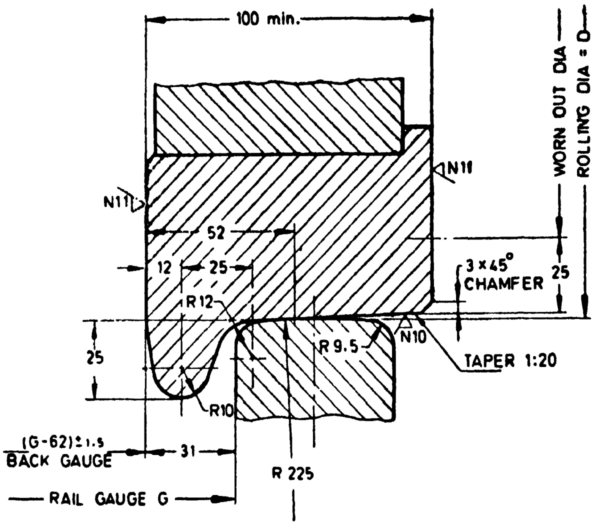
7.8 *Drive*

7.8.1 All gears and sprockets shall be suitably heat treated to achieve the required mechanical properties. The drive to the wheels for the main transmission shall be preferably through roller chains and sprockets.

7.8.2 *Wheels*

7.8.2.1 Locomotives shall have either solid cast steel wheel with integral wheel tyre or steel tyre wheel with cast steel centre. The wheel tyre shall be pressed or shrink fitted on to the wheel centre.

7.8.2.2 The distance between backgauge contour of the flange and tread of wheels shall have dimensions as laid down in Fig. 1.



All dimensions in millimetres.

FIG. 1 DIMENSIONS OF WHEEL CONTOUR

7.8.3 *Axle box*

7.8.3.1 An axle box shall be designed to contain sufficient quantity of grease and shall be dustproof. The axle box housing shall be provided with renewable wear plate when fitted with horn guides.

7.8.3.2 Bearings of axle boxes shall be of antifriction type such as taper roller, spherical roller or cylindrical roller bearing and shall conform to relevant Indian Standards (*see* Appendix A).

7.8.3.3 An axle box shall be so designed that it can allow free vertical movement of horn guides which are fixed to the frame by riveting, welding, bolting or by fitted-bolts.

7.9 *Control Equipment and Instruments* — Following control equipment and instruments including gauges shall be provided on the locomotives for their safe operation. They shall be arranged in the control cabin so as to be within easy reach of the driver from his driving position.

Controls:

a) Engine throttle control;
b) Engine starting and stopping control;
c) Forward-reverse control;
d) Brake control including emergency brake valve (emergency brake control is applicable in case of pneumatic braking);
e) Sanding control; and
f) Horn/warning.

Audio-visual signals or panel lights:

a) Low lubricating oil pressure; and
b) Engine shut-down by safety relay.

Instruments:

a) Engine RPM/hour meter;
b) Engine lube oil pressure gauge;
c) Engine water temperature gauge;
d) Fuel level indicator;
e) Transmission oil temperature gauge (where applicable);
f) Transmission oil pressure gauge (where applicable);
g) Air pressure gague for brake system (where applicable);
h) Battery charge and discharge ammeter; } (for non-flameproof locomotives only)
j) Voltmeter for control circuit; }
k) Mileage indicator; and
m) Speedometer if the speed of a locomotive exceeds 15 km/h on a level rail track.

7.10 *Electricals and Lighting*

7.10.1 A 12/24 Volt electrical system shall be provided on the locomotive complete with batteries, starter motor, dynamo and lighting system.

7.10.2 *Head light* — Each locomotive shall be provided with two head lights, one at each end. The head lights shall be capable of showing any obstacle on the road ahead within 60 m of the locomotives.

7.10.2.1 The head light shall have sufficient range to enable the driver of the locomotive to stop within the limit of his vision when the locomotive is driving at its maximum operational speed.

7.10.3 *Tail light* — A red tail light shall be provided at each end of the locomotive. The tail lights shall be of sufficient power, so as to be clearly visible from a distance of 60 m.

7.10.3.1 Where a locomotive is capable of operation in both directions, the switching circuit for the head light and tail light shall be so arranged that when the head light in one direction is put on, the tail light at the other direction is automatically illuminated.

7.10.4 For diesel locomotives with flameproof characteristics, all electrical apparatus fitted including head light, tail light, instruments and other controls provided on the locomotives shall be either flameproof or intrinsically safe and shall conform to either IS : 2148-1968 'Flameproof enclosures of electrical apparatus (*first revision*)' or IS : 5780-1970 'Intrinsically safe electrical apparatus and circuits'.

7.10.4.1 Cables connecting flameproof apparatus shall be either armoured or conducted, the cables being routed away from the hot surfaces.

7.10.5 *Cabin light* — A suitable cabin light shall be provided, so that all controls and instruments are visible to the driver.

7.11 *Accessories*

7.11.1 Suitable provision shall be made in the locomotive to fix a portable light.

7.11.2 A gong bell shall be provided in the locomotives. In addition, the locomotives may be provided with either electric or pneumatic horn where feasible.

7.11.3 A portable fire extinguisher conforming to IS : 2171-1972 'Portable fire extinguisher dry powder type (*first revision*)' of minimum capacity of 2 kg shall be provided in each of the driver's cabin.

7.11.4 The driver's seat shall be provided in the cabin, so that the driver has good visibility in both front and rear direction without having to lean out of the locomotive. A suitable canopy shall be provided on the cabin to protect the driver from the falling stones and mine rubble falling from the top.

7.11.4.1 The height of the cabin shall be not less than 1 2 m.

7.11.5 Red reflectors shall be provided at each end of the locomotive.

7.11.6 A gauge shall be provided on the driver's control panel to show continuously the air pressure in the reservoir and the pressure in brake cylinder (*see also* **7.9**) whenever the pneumatic brakes are applied.

7.12 *Engine Cooling* — Acceptable venting facilities shall be provided in the engine cooling system. Any radiator cap shall be attached by a chain or other suitable means to prevent accidental loss. A device shall be provided to stop the engine automatically in the event of abnormal rise in the temperature of the cooling water and in any case in the event of temperature exceeding 112°C.

7.13 An instruction manual for proper maintenance and overhaul of locomotive shall be provided with each locomotive.

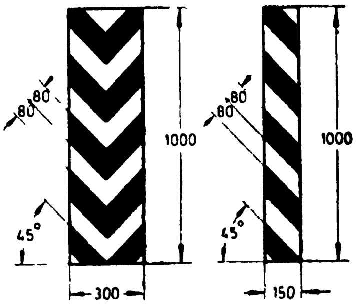
7.14 *Engine Breather* — The engine crankcase breather shall not be connected to the air intake system of the engine. The discharge from the breather shall be directed away from hot surfaces and in such a way as to ensure that the external surfaces of the engine and exhaust system do not become fouled with oil.

7.15 All the components used in the manufacture of diesel engine and locomotive shall conform to Indian Standards. A list of related Indian Standards is given in Appendix A.

8. Painting

8.1 Suitable painting as agreed between the manufacturer and the purchaser shall be applied on the locomotive.

8.2 Luminous paint shall be applied at a conspicuous area on both ends, front and rear, of the locomotive preferably in a recessed portion in addition to the reflector. For guidance the design of painting is indicated in Fig. 2.



TYPE A TYPE B

All dimensions in millimetres.

FIG. 2 DESIGN OF PAINTING ON ENDS OF LOCOMOTIVES

9. Marking — Every locomotive shall be marked with the following informations:

a) Name of the manufacturer of the locomotive;

b) Name of the manufacturer, type and serial number of the diesel engine;

c) Rated power of the engine;

d) The type and setting of the fuel pump of the engine; and

e) The number of the test report of the locomotive.

9.1 *ISI Certification Mark* — Details available with the Indian Standards Institution.

10. Tests — Tests as specified in **10.1** to **10.3** shall be performed at manufacturer's or purchaser's premises. The results of the tests shall be endorsed on a certificate of test (*see* Appendix B).

10.1 *Bench Test of the Drive*

10.1.1 After the complete assembly of the locomotive, it shall be either jacked up or put on test stand and shall be run in either direction for 45 minutes during which various systems such as braking, sanding, power transmission, etc, shall be checked and the results of examination shall be endorsed on test certificate (*see* Appendix B).

10.1.2 In case of hydraulic transmission, the locomotive shall be jacked up allowing the wheels to rotate freely. The engine shall be run for sufficient time to bring all systems to attain working pressure and temperature. The brakes shall then be applied and engine speed gradually increased, stalling the output of the converter. The engine speed at full throttle with the wheels locked by braking shall be recorded. If the wheels start rotating against the brakes, still the engine speed shall be recorded. The temperature and pressure of the torque converter oil, engine water and engine lubricating oil circuits shall be recorded.

10.2 *Running Test*

10.2.1 *No load test* — The locomotive shall be run freely at purchaser's premises on the track covering curves, points, crossing, etc. Performance of brake system and ability of the locomotive to negotiate curves, points, crossing, etc, shall be recorded.

10.2.2 *Half-load test* — On completion of no load test, a trailing load of half of recommended capacity of the locomotive shall be attached to the locomotive. The locomotive shall be run for few hours. Engine speed, oil temperature and pressure, and water temperature shall be recorded.

10.2.3 *Full-load test* — The trailing load shall be increased in steps to full load capacity. The locomotive shall be run on maximum rising gradient and the cruising speed shall be noted. In case the recorded speed of the locomotive with full load is less than the minimum continuous rated speed, the trailing load shall be decreased. By trial and error method, the trailing load shall be adjusted to achieve a speed higher than the minimum continuous rated speed on the maximum ruling gradient.

10.2.3.1 The load arrived at in accordance with **10.2.3** shall be recorded in certificate of test and the purchaser shall be instructed not to exceed this load at any time while using the locomotive.

10.3 *Stand Still Test* — The locomotive shall be brought to rest using any means provided in the locomotive other than direct mechanical action. The locomotive shall be kept at rest for a minimum period of 10 minutes. No leakage shall occur in the air/hydraulic circuits of the braking system of locomotives during or after the completion of this test.

11. Information to be Supplied by User While Ordering — While ordering, the user shall give the following information to the manufacturer:

a) Track gauge;

b) Maximum ruling gradient against the load;

c) Minimum radius of curvature of track;

d) Maximum allowable axle load in tonnes;

e) Maximum speed limit desired;

f) Acceptable maximum length of locomotive over buffers;

g) Acceptable maximum width of locomotive over hand rails/farthest projection;

h) Maximum permissible height of locomotive; and

j) If tunnels exist, the tunnel size may be given.

12. Information to be Supplied by Manufacturer — The following information shall be supplied with each locomotive by the manufacturer to the user at the time of supplying:

a) Type of locomotive;

b) Number of axles;

c) Maximum rigid wheel base;

d) Weight of locomotive;

e) Maximum axle load;

f) Diameter of wheel when new;

g) Diameter of wheel at recommended condemning limit;

h) Minimum clearance above rail level with new wheels;

j) Installed power of the diesel engine at standard conditions;

k) Derating, if any, on the diesel engine for working at site conditions (specify following site conditions):

   i) Altitude in metres above m. s. l.,

   ii) Maximum ambient temperature, and

   iii) Humidity

m) Type of transmission (hydraulic/mechanical/hydrostatic);

n) Minimum continuous rated speed of locomotive (for hydraulic transmission);

p) Maximum tractive effort at wheels attainable at minimum continuous rated speed;

q) Fuel tank capacity; and

r) Maximum braking distance at specifications.

APPENDIX A

(*Clauses* 7.8.3.2 *and* 7.15)

LIST OF INDIAN STANDARDS RELATING TO DIESEL LOCOMOTIVES FOR USE IN MINES

A-1. Diesel Engines

IS : 810-1974	Inlet and exhaust valves for internal combustion engines (*first revision*)
IS : 3170-1965	Dimensions for injection nozzles, size 'S', for diesel engines
IS : 3171-1965	Dimensions for injection nozzle holders, size 'S', for diesel engines
IS : 3172-1974	Brazed type pipe unions (*first revision*)
IS : 3173-1965	High pressure connections for fuel injection equipment for diesel engines
IS : 3174-1974	Pipe union bolt (*first revision*)
IS : 3175-1974	Sealing washers for pipe unions (*first revision*)
IS : 3351-1968	Methods of test for diesel engine fuel filters
IS : 3511-1966	Cylinder bore diameter for internal combustion engines
IS : 5791-1977	Technical supply conditions for piston rings for IC engines
IS : 6740-1972	Technical requirements for gudgeon pins for Internal combustion engines
IS : 6750-1972	Technical supply conditions for cylinder liners for internal combustion engines
IS : 7449 (Part I)-1974	Glossary of terms for IC engines : Part I Fuel injection equipment
IS : 7451 (Part IV)-1974	Reciprocating internal combustion engines : Part IV Designation of direction of rotation
IS : 7451 (Part VI)-1974	Reciprocating internal combustion engines : Part VI Hand operated control devices — standard direction of motion

IS : 8422 (Part I)-1977 Piston rings for IC engines : Part I R-rings — Plain compression rings from 30 up to 200 mm nominal diameter

IS : 8422 (Part II)-1977 Piston rings for IC engines : Part II M-rings — Taper faced compression rings from 30 up to 200 mm nominal diameter

IS : 8422 (Part III)-1977 Piston rings for IC engines : Part III T-rings — 15°-keystone rings from 82 up to 200 mm nominal diameter

IS : 8422 (Part IV)-1977 Piston rings for IC engines : Part IV N-rings — Napier oil scraper rings from 30 up to 200 mm nominal diameter

IS : 8422 (Part V)-1977 Piston rings for IC engines : Part V Z-rings — Stepped oil scraper rings from 30 up to 200 mm nominal diameter

IS : 8422 (Part VI)-1977 Piston rings for IC engines : Part VI S-rings — Slotted oil control rings from 50 up to 200 mm nominal diameter

IS : 8422 (Part VII)-1977 Piston rings for IC engines : Part VII G-rings — Double bevelled slotted oil control rings from 50 up to 200 mm nominal diameter

IS : 8422 (Part VIII)-1977 Piston rings for IC engines : Part VIII D-rings — Narrow land slotted oil control rings from 50 up to 200 mm nominal diameter

IS : 8503-1977 Technical supply conditions for aluminium alloy pistons for internal combustion engines

A-2. Fasteners

IS : 549-1974 Split pins (*second revision*)

IS : 1363-1967 Black hexagon bolts, nuts and lock nuts (dia 6 to 39 mm) and black hexagon screws (dia 6 to 24 mm) (*first revision*)

IS : 1364-1967 Precision and semi-precision hexagon bolts, screws, nuts and lock nuts (dia range 6 to 39 mm)

IS : 1367 (Part I)-1980 Technical supply conditions for threaded steel fasteners : Part I introduction and general information (*second revision*)

IS : 1367 (Part II)-1979 Technical supply conditions for threaded steel fasteners : Part II Product grades and tolerances (*second revision*)

IS : 1367 (Part III)-1979 Technical supply conditions for threaded steel fasteners : Part III Mechanical properties and test methods for bolts, screws and studs with full loadability (*second revision*)

IS : 1367 (Part VI)-1980 Technical supply conditions for threaded steel fasteners : Part VI Mechanical properties and test methods for nuts with specified proof loads (*second revision*)

IS : 1367 (Part VII)-1980 Technical supply conditions for threaded steel fasteners : Part VII Mechanical properties and test methods for nuts without specified proof loads (*second revision*)

IS : 1367 (Part IX)-1979 Technical supply conditions for threaded steel fasteners : Part IX Surface discontinuities on bolts, screws and studs (*second revision*)

IS : 1367 (Part X)-1979 Technical supply conditions for threaded steel fasteners : Part X Surface discontinuities on nuts (*second revision*)

IS : 1367 (Part XVI)-1979 Technical supply conditions for threaded steel fasteners : Part XVI Designation system and symbols (*second revision*)

IS : 1367 (Part XVIII)-1979 Technical supply conditions for threaded steel fasteners : Part XVIII Marking and mode of delivery (*second revision*)

IS : 1368-1980 Dimensions of ends of bolts and screws (*second revision*)

IS : 1369-1975 Dimensions of screw thread run-outs and under-cuts (*first revision*)

IS : 1821-1967 Dimensions for clearance holes for metric bolts (*first revision*)

IS : 1862-1975 Studs (*second revision*)

IS : 2232-1967 Slotted and castle nuts (*first revision*)

IS : 2269-1967 Hexagon socket head cap screws (*first revision*)

IS : 2393-1980 Cylindrical pins (*second revision*)

IS : 2585-1968 Black square bolts and nuts (dia range 6 to 39 mm) and black square screws (dia range 6 to 24 mm) (*first revision*)

IS : 2614-1969 Methods for sampling of fasteners (*first revision*)

IS : 3138-1966 Hexagonal bolts and nuts (M42 to M150)

IS : 3640-1967 Hexagon fit bolts
IS : 4172-1967 Dimensions for radii under the head of bolts and screws
IS : 4206-1967 Dimensions for nominal lengths and thread lengths for bolts, screws and studs
IS : 4499-1968 Dimensions for depth of holes for studs
IS : 6688-1972 Taper pins
IS : 6862-1973 Clevis pin
IS : 7790-1975 Domed cap nuts
IS : 7795-1975 Hexagon nuts with collar
IS : 8535-1977 Terminology for features of fasteners
IS : 8536-1977 Dimensioning of fasteners
IS : 8537-1977 Nomenclature and terminology of fasteners
IS : 9519-1980 Width across flats for hexagon head bolts and nuts
IS : 9549-1980 Dimensions for split pin holes, wire holes and head slots for bolts

A-3. Bearings

IS : 2398-1967 Identification code for rolling bearings
IS : 3090-1965 Code of practice for installation and maintenance of rolling bearings
IS : 3823 (Part I)-1966 Methods of evaluating static load ratings of rolling bearings: Part I Radial ball bearings
IS : 3823 (Part II)-1966 Methods of evaluating static load ratings of rolling bearings : Part II Radial roller bearings
IS : 3823 (Part III)-1966 Methods of evaluating static load ratings of rolling bearings : Part III Thrust ball bearings
IS : 3823 (Part IV)-1966 Methods of evaluating static load ratings of rolling bearings: Part IV Thrust roller bearings
IS : 3824 (Part I)-1966 Methods of evaluating dynamic load ratings of rolling bearings: Part I Radial ball bearings
IS : 3824 (Part II)-1966 Methods of evaluating dynamic load ratings of rolling bearings: Part II Radial roller bearings
IS : 3824 (Part III)-1966 Methods of evaluating dynamic load ratings of rolling bearings: Part III Thrust ball bearings
IS : 3824 (Part IV)-1966 Methods of evaluating dynamic load ratings of rolling bearings: Part IV Thrust roller bearings
IS : 5669-1970 General plan of boundary dimensions for radial roller bearings
IS : 5692-1970 Tolerances for radial roller bearings
IS : 5932-1970 Boundary dimensions for thrust ball bearings with flat seats
IS : 5933-1970 Tolerances for thrust ball bearing with flat seats
IS : 6453-1972 Technical supply conditions for rolling bearings
IS : 6454-1972 Self aligning roller bearings
IS : 6455-1972 Single row radial ball bearings
IS : 6456-1972 Double row radial ball bearings
IS : 6457-1972 Single row cylindrical roller bearings
IS : 6458-1972 Double row cylindrical roller bearings
IS : 7460-1974 Tolerances for tapered roller bearings
IS : 7461-1974 General plan of boundary dimensions for tapered roller bearings

A-4. Miscellaneous

IS : 2048-1975 Parallel keys and keyways (*first revision*)
IS : 2291-1976 Tangential keys and keyways (*first revision*)
IS : 2292-1974 Taper keys and keyways (*first revision*)
IS : 2403-1975 Transmission steel roller chains and chain wheels (*first revision*)
IS : 2712-1971 Compressed asbestos fibre jointing (*first revision*)
IS : 3688-1966 Dimensions for shaft ends (*first revision*)
IS : 4278-1973 Speedometer cables (*first revision*)
IS : 7714-1975 Method of sealability test for gasket material

IS : 7906 (Part I)-1976 Helical compression springs : Part I Design and calculation for springs made from circular section wire and bar

IS : 7906 (Part II)-1975 Helical compression springs : Part II Cold coiled springs made from circular section wire and bar

IS : 7906 (Part III)-1975 Helical compression springs : Part III Data sheet for specifications for springs made from circular section wire and bar

IS : 7907 (Part I)-1976 Helical extension springs : Part I Design and calculation for springs made from circular section wire and bar

IS : 7907 (Part II)-1976 Helical extension springs : Part II Cold coiled springs made from circular section wire and bar

IS : 7907 (Part III)-1975 Helical extension springs : Part III Data sheet for specification for springs made from circular section wire and bar

APPENDIX B

(*Clauses* 10 *and* 10.1.1)

TEST CERTIFICATE FOR DIESEL LOCOMOTIVES FOR USE IN MINES

The test certificate for diesel locomotives for use in mines shall contain the following information:

a) Identification of locomotive;

b) Name of manufacturer;

c) Overall dimensions;

d) Minimum rail clearance;

e) Performance of engine starting system;

f) Time taken for build up of compressed air pressure in the system (if applicable);

g) Performance of various systems of locomotive during bench test (*see* **10.1**):

  i) Electrical system,

  ii) Brake system,

  iii) Sanding system,

  iv) Horn,

  v) Wind screen wiper,

  vi) Power transmission,

  vii) Leakage in oil, air and fuel pipe line system,

  viii) In case of hydraulic transmission, give the following information (*see* **10.1.2**);

    1) Engine speed,

    2) Temperature and pressure of torque converter oil,

    3) Cooling water temperature and pressure,

    4) Lubricating oil temperature and pressure;

h) Results of running test at no-load (*see* **10.2.1**);

j) Results of running test at half-load (*see* **10.2.2**):

  i) Speed of engine,

  ii) Temperature and pressure of oil,

  iii) Temperature of cooling water;

k) Results of running test at full-load (*see* **10.2.3.1**):

  i) Maximum trailing load to be attached to locomotive,

  ii) Cruising speed with maximum trailing load at maximum rising gradient; and

m) Results of stand still test (*see* **10.3**).

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